Claims

1. Rechargeable electrochemical battery cell having a negative electrode (5), an electrolyte (19), and a positive electrode (4), the negative electrode (5) comprising an electronically conductive substrate (14), on which an active mass (15) is electrolytically deposited when charging the cell,

characterized in that

the battery cell comprises a porous structure (16) contacting the substrate (14) of the negative electrode (5) and made of solid particles (17), which porous structure is formed and positioned in such a manner that the active mass (15) deposited during charging of the cell penetrates from the surface of the substrate (14) into its pores (18) and is further deposited therein.

2. Battery cell according to claim 1, characterized in that the volume proportion of the solid particles (17) in the porous structure is at least 40 %, preferably at least 50 %, and especially preferably at least 55 %.

3. Battery cell according to any one of the preceding claims, characterized in that, in order to increase the bulk density, the shape of the solid particles (17) which form the porous structure (16) approximates a spherical shape.

4. Battery cell according to any one of the preceding claims, characterized in that the porous structure (16) contains at least two fractions of structure-forming solid particles (23,24) having different average particle sizes and the particle sizes of the fractions are adapted to one another in such a manner that an increased volume proportion of the particles results.

5. Battery cell according to any one of the preceding claims, characterized in that the substrate (14) is sheet-shaped and is positioned parallel to a sheet-shaped separator (11) which separates the negative electrode from a positive electrode, and the porous structure (16) completely fills the space between the substrate (14) and the separator (11) in such a manner that there are no cavities in which accumulations of the mass (15) deposited during charging the cell could form and which are substantially larger than the pores (18) of the porous structure (16).

6. Battery cell according to any one of the preceding claims, characterized in that the material of the solid particles (17) of the porous structure (16) is inert relative to the electrolyte, its overcharge products, and the active mass.

7. Battery cell according to claim 6, characterized in that the material is a ceramic powder.

8. Battery cell according to any one of the preceding claims, characterized in that the material of the solid particles (17) of the porous structure is not an ionically dissociating material.

9. Battery cell according to any one of the preceding claims, characterized in that the solid particles (17) of the porous structure have a melting point of at least 200 °C, preferably at least 400 °C.

10. Battery cell according to any one of the preceding claims, characterized in that the material of the solid particles (17) of the porous structure (16) has a thermal conductivity of at least 5 W/mK, preferably at least 20 W/mK.

11. Battery cell according to any one of the preceding claims, characterized in that the solid particles (17) of the porous structure (16) contain an oxygen-free compound, in particular a carbide, nitride, or phosphide.

12. Battery cell according to claim 11, characterized in that the solid particles (17) contain a carbide, nitride, or phosphide of silicon.

13. Battery cell according to any one of the preceding claims, characterized in that the porous structure (16) is made of solid particles (17) which are not bonded to one another.

14. Battery cell according to any one of claims 1 to 12, characterized in that the solid particles (17) of the porous structure (16) are bonded to one another by a binder, the volume proportion of the binder to the total solid volume of the porous structure being at most 50 %, preferably at most 30 %, especially preferably at most 20 %, and even more preferably at most 10 %.

15. Battery cell according to any one of the preceding claims, characterized in that the porous structure (16) contains a solid salt (26).

16. Battery cell according to claim 15, characterized in that the solid salt (26) is contained in the porous structure (16) in the form of finely divided particles (27), the salt particles (27) being so much smaller than the solid particles (17) of which the porous structure (16) is made that the salt particles fit into the pores (18) of the porous structure (16).

17. Battery cell according to claim 16, characterized in that the size ratio of the average particle size of the salt particles (27) to the average particle size of the solid particles (17) of which the porous structure (16) is made is less than 1:2, preferably less than 1:4, and especially preferably less than 1:8.

18. Battery cell according to one of claims 16 to 17, characterized in that the proportion of the total volume of the salt particles to the total solid volume of the porous structure (16) is at most 20 %, preferably at most 10 %, and especially preferably at most 5 %.

19. Battery cell according to any one of the preceding claims, characterized in that the electrolyte is based on sulfur dioxide.

20. Battery cell according to any one of the preceding claims, characterized in that the active mass (15) is selected from the group comprising the alkali metals,

the alkaline earth metals, and the metals of the second subgroup of the periodic system.

21. Battery cell according to claim 20, characterized in that the active mass (15) is lithium, sodium, calcium, zinc, or aluminum.

22. Battery cell according to any one of the preceding claims, characterized in that the positive electrode (4) contains a metal oxide.

23. Battery cell according to claim 22, characterized in that the positive electrode (4) contains an intercalation compound.

Abstract

A rechargeable electrochemical battery cell having a negative electrode (5), an electrolyte (19), and a positive electrode (4), the negative electrode (5) having an electronically conductive substrate (14), on which an active mass (15) is electrolytically deposited when the cell is charged.

A significant improvement of the operating safety is achieved in that the cell has a porous structure (16) made of solid particles (17) in contact with the substrate (14) of the negative electrode (5), which porous structure is formed and positioned in such a manner that the active mass (15) deposited during charging of the cell penetrates from the surface of the substrate (14) into its pores (18) and is further deposited therein.

(figure 4)